Coupling molecular spin states by photon-assisted tunneling

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Artificial molecules containing just one or two electrons provide a powerful platform for studies of orbital and spin quantum dynamics in nanoscale devices. A well-known example of these dynamics is tunneling of electrons between two coupled quantum dots triggered by microwave irradiation. So far, these tunneling processes have been treated as electric dipole-allowed spin-conserving events. Here we report that microwaves can also excite tunneling transitions between states with different spin. In this work, the dominant mechanism responsible for violation of spin conservation is the spin-orbit interaction. These transitions make it possible to perform detailed microwave spectroscopy of the molecular spin states of an artificial hydrogen molecule and open up the possibility of realizing full quantum control of a two spin system via microwave excitation

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